



ECN

Your energy. Our passion.

Industrial Energy Efficiency



From Research to Market: Innovative Technologies for Energy Savings

Despite energy conservation efforts, energy use continues to increase, partly due to growth in production and consumption. Since energy prices have also continued to grow, it is very important that energy sources are used more efficiently. Only through new technologies and systems a substantial and sustainable improvement in energy efficiency can be achieved. Finding new ways to make the industry more sustainable are required to meet European climate change standards.

With and for the market ECN develops knowledge and technology that enable a transition to a sustainable energy system. ECN is carrying out research in cooperation with universities and is always considering the commercial possibilities of its innovations. Private and public parties in government and industry can benefit from our extensive knowledge on sustainable energy technologies.

ECN focuses its R&D activities on reducing energy consumption, with particular attention for thermal energy in production processes. These activities and technologies will lead to major energy savings. We work actively to implement the solutions we develop by entering into partnerships with interested parties such as feedstock suppliers, engineering contractors, equipment manufacturers and end users. As a result, ECN is not only a research institute, but also an organization that interacts with all parties involved – government, energy companies, suppliers and (industrial) end users – to improve the sustainability of the energy system in a commercially sound manner.

Reduce Energy Costs with Innovative Heat Technologies

The use of heat within industry is responsible for more than 80% of the final energetic energy use. Heat is used for heating feedstock, enable reactions, and to drive separation processes. The required temperature level spans a broad range, depending on the specific process. At the same time, large quantities of waste heat are released to the ambient atmosphere that cannot be reused in an economical way.

Upgrading of (Waste)Heat

The upgrading of waste heat to process heat can be achieved by applying heat pump technology. Commercially available heat pump technology is limited both in operating temperature and temperature lift. ECN works on innovative heat pump concepts that are able to provide heat at temperatures $> 200^{\circ}\text{C}$ with temperature lifts of $50\text{--}100^{\circ}\text{C}$. The same concepts can also be applied to provide cooling from waste heat.

Storage of (Waste)Heat

Storage of heat is a technology that can overcome the time difference between the supply and the demand of heat. Heat storage can improve the overall system efficiency and enables the decoupling of sectors, processes or systems which provides more flexibility. ECN has knowledge and experience of on all types of heat storage (sensible, latent, thermochemical) and their specific field of application (industry, transport, buildings).





Separation Technology for Energy Efficient Processes

Classic separation processes, such as distillation, demand large quantities of energy. About 6% of the energy consumption in the Netherlands is attributable to these processes, predominantly in the process industry. By applying molecular separation (e.g. with membranes, sorbents and solvents), the energy efficiency of the processes can be greatly improved. Three advanced developments in this area are the HybSi® membrane, the Hysep® module and sorbents for gas treatment & upgrading.

Breakthrough in a world of Membrane Technology: HybSi®

A separation technology with which ECN is achieving impressive results is pervaporation, or the selective evaporation of a component of a liquid through a membrane. In contrast with conventional distillation technology, with HybSi® only the separated substance is evaporated, which results in a vast savings in energy of up to 50%. The organic-inorganic hybrid HybSi® membrane developed and patented by ECN eliminates a number of the limitations of conventional polymer membranes. The fact that the membrane remains stable at high temperatures and in aggressive liquids open up a large number of applications in the process industry.

Hysep®: more Efficient Hydrogen Production is possible

In view of the increasing use of hydrogen in the sustainable economy of the future, ECN is studying the integration of hydrogen production and membrane separation. It has developed a membrane reactor that enables the separation process to take place at a much lower temperature (550 to 650°C), which results in a huge savings in energy. This Hysep® module contains a membrane with an extremely thin layer of palladium, and is suitable for applications like recycling hydrogen from industrial gas streams. ECN is the first in the world to have actually sold a product based on such a module. ECN is looking for a commercial partner to scale up the production. Hysep® is also used for pre-combustion CO₂ capture.

Sorbents for Gas Treatment & Upgrading

Natural gas, biogas and exhaust gases from combustion processes contain significant amount of sour components such as CO₂ and sulphur impurities. Current technologies for removing these components, in order to meet the environmental regulations or to upgrade the gas for pipeline specifications, use significant amounts of energy and are unsuitable to downscale either for small gas fields or for atmospheric biogas treating.

ECN works on the development of innovative cost effective CO₂ removal technologies which may be tailored for efficient operation at any scale, from small scale for gas upgrading application (biogas cleaning) to large point sources such as coal or gas fired power plants. Its unique feature relies on advanced integration of highly stable regenerative material in an innovative reactor concept.

Process Intensification for Bulk Chemicals

Process intensification is the combination of operations within a process to create more compact and more efficient novel equipment and systems. This involves many different technologies, which share the common feature of increasing efficiency by reducing the scale of the processes. In this area, ECN is mainly working with the large chemical industry to develop sorption enhanced reactors, distillation columns with heat integration and structured reactors.

HiDiC: Energy Efficient Distillation

Distillation is by far the most important separation technique in the chemical and refinery industries, and is also the largest user of energy. Distillation accounts for about 40 % of the energy use in this sector. Investment in distillation equipment in the Dutch petrochemical industry continues at about 700 M€ per year. The Heat Integrated Distillation Column (HiDiC) integrates heat transfer and separation. Two concepts of this advanced distillation technology are being developed in a consortium led by ECN. Where the first concept is based on modification of conventional distillation columns, the second represents a more radical approach where distillation takes place within the channels of a modified heat exchanger. Several business cases have confirmed the cost and energy savings.

We are experts in a range of areas, from conceptual process design to material development, and from process testing to reactor design.

Leading the way on CO₂ Capture and Utilisation

For almost two decades, ECN has been at the forefront of research into CO₂ capture and utilization (CCU), and commercialisation of CCU. We focus on two main areas: the key policy aspects of CCU, and the development of specific technologies to make CO₂ capture and utilization less expensive and more energy efficient. We are experts in a range of areas, from conceptual process design to material development, and from process testing to reactor design. ECN is developing pre-combustion CO₂ & oxyfire capture technologies to transform CO₂ capture into a benefit, e.g. by using the separation of CO₂ to enhance the production of hydrogen fuel.

Sorption-Enhanced Water Gas Shift (SEWGS)

SEWGS combines the production of hydrogen from syngas with the separation of CO₂ in one process step. This technology is unique in that it is carried out at high temperatures (300-400°C). SEWGS reduces the penalty of CO₂ and also lowers the capital costs for by combining several process steps into one, and by alleviating the need for heating and cooling steps. Together with industrial partners we are developing the complete SEWGS technology from CO₂ sorbents to the entire process set-up for application in natural gas and coal gas fuelled power plants.

Chemical Looping Combustion (CLC)

Combustion is at the heart of many processes that produce both power and chemicals. Oxygen (O₂) is the only component in air that is either used or needed for combustion or partial combustion, but represents only 1/5 of the air by volume. Providing energy efficient separation of O₂ from air can be achieved, combustion processes can be performed with a much higher efficiency than otherwise. Chemical Looping Combustion (CLC) is a technology in which effectively separates O₂ from the air before combustion takes place. ECN works together with industry and universities on the improvement of CLC materials and efficient implementation of the technology.

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